Patent Claims

1. A superconducting magnesium diboride composite, comprising a superconducting magnesium-boride phase component and a metallic phase component, said composite obtainable from a porous magnesium boride preform component, said preform component comprising magnesium and boron, and introduction of a metallic component into said pores of said preform component, said introduction with at least one of temperature and pressure sufficient to infiltrate said preform, said metallic component selected from the group consisting of metals, alloys and combinations thereof, said metallic component having at least one of a melting point and a liquidus temperature less than about 1100°C.

2. The composite of Claim 1 wherein said superconducting phase component has a volume fraction greater than about 19% of said composite.

3. The composite of Claim 2 wherein said superconducting phase component comprises magnesium diboride.

4. The composite of Claim 3 wherein said superconducting phase has a volume fraction between about 20% and about 90% of said composite.

5. The composite of Claim 4 wherein said superconducting phase component is a multi-element phase comprising magnesium and boron.

6. The composite of Claim 1 wherein said metallic phase component comprises a component selected from the group consisting of metals, alloys and combinations thereof, said metallic phase component having a melting point less than about 1100°C, and said composite substantially without degradation of said superconducting phase component.

7. The composite of Claim 6 wherein said metallic phase component is selected from the group consisting of magnesium metal and a magnesium alloy, and said superconducting phase component comprises magnesium diboride, said superconducting phase component having a volume fraction greater than about 19% of said composite.

8. The composite of Claim 7 further including a non-superconducting phase to enhance composite function.

9. A superconducting composite comprising a magnesium diboride superconducting phase component and a magnesium phase component, said magnesium diboride superconducting phase having a volume fraction greater than about 19% of said composite.

10. The composite of Claim 9 wherein said superconducting magnesium diboride phase is a multi-element phase comprising magnesium and boron.

11. A composite of Claim 9 wherein said superconducting phase has a volume fraction between about 20% and about 90% of said composite.

12. The composite of Claim 9 wherein said magnesium phase is a magnesium alloy including another metallic component selected from the group consisting of metals, alloys and combinations thereof, said other metallic component having a melting point less than about 1100°C and said composite substantially without degradation of said superconducting phase.

13. The composite of Claim 9 further including a non-superconducting phase to enhance composite function, said non-superconducting phase at least one of graphite, a metal, a ceramic, and a polymer material.

14. The composite of Claim 9 wherein said magnesium diboride superconducting phase comprises substantially straight aligned fibers.

15. The composite of Claim 9 having a preformed configuration.

16. A method of preparing a metallic magnesium diboride composite, said method comprising:

providing a porous magnesium diboride preform component; and

introducing a metallic component into said pores of said preform component, said introduction with at least one of temperature and pressure sufficient to infiltrate said preform, said metallic component selected from the group consisting of metals, alloys and combinations thereof, said metallic component having at least one of a melting point and a liquidus temperature less than about 1100°C.

17. The method of Claim 16 wherein said magnesium diboride has a volume fraction greater than about 19% of said composite.

18. The method of Claim 17 wherein said magnesium diboride has a volume fraction between about 20% and about 90% of said composite.

19. The method of Claim 18 wherein said metallic component is selected from the group consisting of Cu, Au, Ag, Al, Mg, Zn, Pb, Cd, Bi, Sn, In, Ga, and Hg metals, alloys of said metals and combinations thereof.

20. The method of Claim 19 wherein said metal is Mg.

21. The method of Claim 16 wherein said preform component comprises at least one of magnesium diboride particles, platelets, an interconnected sponge and fibers.

22. The method of Claim 21 wherein said preform comprises aligned fibers of magnesium diboride having a volume fraction greater than about 19% of said composite.

23. A method for in situ preparation of a magnesium diboride phase, said method comprising:

providing a porous preform of a diboride precursor component; introducing a magnesium component to said preform, said magnesium component; and

chemically reacting said magnesium component and said diboride precursor component to provide a magnesium diboride phase, said magnesium component reacting at least partially with said diboride precursor component and said magnesium diboride comprising magnesium and boron.

24. The method of Claim 23 wherein said diboride precursor is selected from the group consisting of boron, a boron-containing compound and combinations thereof.

25. The method of Claim 24 wherein said magnesium component is in an amount sufficient to provide said magnesium diboride phase as a composite with said magnesium component.

26. The method of Claim 25 wherein said diboride precursor and said magnesium component provide a superconducting magnesium diboride phase having a volume fraction greater than about 19% of said composite.

27. The method of Claim 26 wherein said magnesium component is selected from the group consisting of magnesium metal, a magnesium alloy and combinations thereof.

28. The method of Claim 24 wherein said diboride precursor is boron and said metallic component is magnesium metal.

29. The method of Claim 28 wherein said diboride precursor comprises boron fibers, said fibers selected from the group consisting of coated boron fibers and non-coated boron fibers.

30. A method of preparing a magnesium-magnesium diboride composite, said method comprising:

providing a diboride precursor component, said precursor component selected from the group consisting of boron, a boron-containing compound, magnesium diboride and a combination thereof;

incorporating a magnesium component with said precursor component to provide a component mixture; and

compacting said component mixture with at least one of a temperature and pressure sufficient to bond said magnesium component.

31. The method of Claim 30 wherein said diboride precursor component is magnesium diboride powder.

32. The method of Claim 30 wherein said diboride precursor is a boron-containing compound, said compound a solid solution of magnesium diboride and at least one additional component.

33. The method of Claim 30 wherein said magnesium component further includes another metallic component.

34. The method of claim 30 further including heat treatment of said component mixture to provide at least partial chemical reaction of said magnesium component with said precursor treatment.